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Greek Banking Sector Stock Reaction to ECB's Monetary Policy Interventions

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Abstract: Reacting to extreme uncertainty conditions caused by the global financial crisis, the European Central Bank implemented countercyclical strategy, combining conventional and non-traditional monetary policy tools to stabilize financial markets and euro area economies. We study the impact of the euro area monetary authority policy interventions on equity returns of four systemic Greek banks for the period January 2007 to August 2018. In the first step, we collect and classify interventions to several categories. Then, an event study analysis is carried out to evaluate cumulative abnormal returns. In the second step, a panel regression analysis is performed to identify Cumulative Abnormal Return (CAR) determinants. Our results suggest that expansionary conventional monetary policy interventions significantly affect equity returns of Greek banking institutions, assisting the regional banking equity stability. On the other hand, the harmful consequences of Greek debt crisis limited the effectiveness of non-standard measures.

Keywords: monetary policy; regional banking operations; central bank; panel regression analysis

1. Introduction

Due to the sharp deterioration of the fiscal and macroeconomic environment in 2009, the consequent deterioration of Greece's credit rating resulted among other reasons in the gradual country's exclusion from the international capital and money markets[1]. Additionally, the significant outflow of deposits, the fall in the prices of collateral (i.e., the real estate, government, and corporate bonds) of loans and the stifling liquidity conditions have also put intense pressure on the Greek banking sector. In early 2010, Greece's financial position was unsuitable due to budget deficit, the acceleration of debt stock and the dramatic rise in government bond yields. Therefore, investors worried about a possible Greek sovereign default (Cour-Thiman and Winkler 2013). In May 2010, Greece's first economic adjustment program was arranged with the International Monetary Fund (IMF), the European member states, and the European Central Bank (ECB), totaling a multilateral loan of EUR 110 billion to avoid bankruptcy and improve fiscal imbalances. The imminent European sovereign debt crisis caused other peripheral member states to launch economic adjustment programs including Ireland, Portugal, and Spain[2]. To calm down the markets, the ECB launched the Securities Market Programme (SMP) and bought public debt bonds issued by the distressed peripheral Eurozone member states in secondary markets.

The ongoing economic recession forced Greece to launch a second economic adjustment program in March 2012 alongside the implementation of sovereign debt restructuring. The Greek debt exchange deal, with the voluntary involvement of the private sector, managed to reduce the debt burden by EUR 107 billion (Zettelmeyer et al. 2013) while the yields of government bonds declined significantly. In December 2012, the Greek government performed a bond buy-back operation to decrease the debt-to-GDP ratio by another EUR

21 billion. The second adjustment program alongside the private sector involvement (PSI) prevented Greece exiting the Eurozone but the sharpness of recession lead to a third, three-year adjustment program, in August 2015. Finally, in 2018, the gross domestic product started to grow, the budget introduced a surplus, and Greece could raise funding from capital markets. On 20 August 2018, Greece exited the third adjustment program. We must point out that the granted bailout loans agreed in parallel with the three programs were accompanied with austerity measures (tax increases and spending cuts) as well as with structural reforms.

In the onset of financial crisis, the Greek economy was foremost bank-based while the regional monetary financial institutions (MFIs) were healthy and resilient as they were among the best capitalized banks in Europe but, eventually, the regional banking sector was weakened by the sovereign debt crisis (Avramidis et al. 2020). The outburst of sovereign debt crisis led rating agencies to downgrade Greece affecting negatively both assets used as collateral by the Greek MFIs in the refinancing operations performed by the ECB as well as the MFIs' own credit ratings (Louri and Migiakis 2019). To support Greek MFIs, the ECB four times decided to waive the quality threshold for accepting Greek debt securities as collateral in refinancing operations. The ECB's liquidity provision to Greek MFIs was crucial for avoiding a possible bank default as there was increasing demand for deposit withdrawals during the Greek public debt crisis. In June 2015, capital controls were imposed to avoid full-scale bank run. In addition, the Greek debt exchange deal caused severe losses to the Greek MFIs balance sheets (around 45 billion) decreasing dramatically capital adequacy ratios. An amount of 40 billion from the multilateral loan of the second adjustment program was used to recapitalize Greek banks[3]. Another recapitalization of 10 billion was held in 2015 from the funds foreseen in the third adjustment program.

This research paper explores the impact of the European Central Bank's monetary policy on stock returns of the systematically important Greek regional banks. Our study lasts from 2007 to 2018, so it covers the subprime crisis phase, the financial crisis phase, the European sovereign debt crisis period, and the three Greek economic adjustment programs. Banks under investigation are the National Bank of Greece, Alpha Bank, Eurobank E.F.G., and Piraeus Bank. These banks participated in the capital exercise of 2011/2012 as well as in the comprehensive assessments of 2014 and 2015 organized by the ECB and have been characterized as systemic banks.

We state herein the research questions processed under the framework of this research:

R.Q. 1: What is the Greek banking sector response to the ECB's standard monetary policy announcements?

R.Q. 2: Does the Greek banking sector react to the ECB's expansionary unconventional monetary policy announcements?

Our research contributes to the literature because there is no exclusive study on the effects of the ECB's both conventional and non-standard measures on equity returns of Greek MFIs which were operating in a stressed economy with high recession and large fiscal deficits. In relation with other Eurozone member states, Greece was hit harder by the sovereign debt crisis and was the only peripheral country that implemented three adjustment programs. Additionally, policy makers and investors are interested in evaluating equity performance of regional banks especially during periods of strong financial tension.

Our empirical findings suggest that expansionary conventional monetary policy measures significantly affect bank equity returns. This type of policy is found to be efficient in restoring investors' trust in the Greek banking industry. On the other hand, the sharpness of the recession, the uncertainty about the country's prospects as a member state of Eurozone, the three economic and adjusted programs implemented by the Greek government, the restructuring of public debt, the high stock of non-performing loans, and finally the imposition of capital controls resulted in the gradual loss of investors' confidence towards the Greek economy and regional monetary financial institutions. As a result, investors gradually shifted their holdings from Greece to core Eurozone countries limiting the impact of non-standard measures.

The structure of this paper is organized in the following way. The next section introduces monetary policy instruments adopted in the euro area by the ECB. Section 3 reviews relevant studies on research subject and Section 4 describes the monetary policy channels of transmission. In Section 5 we present the empirical approach, the data, and the methodology. In Section 6, we refer to the main results of this study. Conclusion and suggestions for further research are presented in Section 7.

2. Monetary Policy Interventions in the Euro Area

Counteracting the global financial and the European debt crisis, the ECB launched both conventional and nonstandard monetary instruments to improve the transition of monetary policy.

Specifically, from the beginning of the economic crisis, the ECB quickly decreased the main refinancing operations rate (MROr) and other standing facilities rates (deposit facility—DFr; marginal lending facility—MLFr) to the zero-lower-bound level. As shown in Figure 1, since the last four months of 2008, the ECB cut rapidly the MROr from 4.25% to 1%, then it remained stable until mid-2011, and after slight increases, it declined to the zero-bound level. The same path followed DFr and MLFr. From mid-2014 we observe a negative rate policy on deposit facility (Fiorelli and Meliciani 2019).
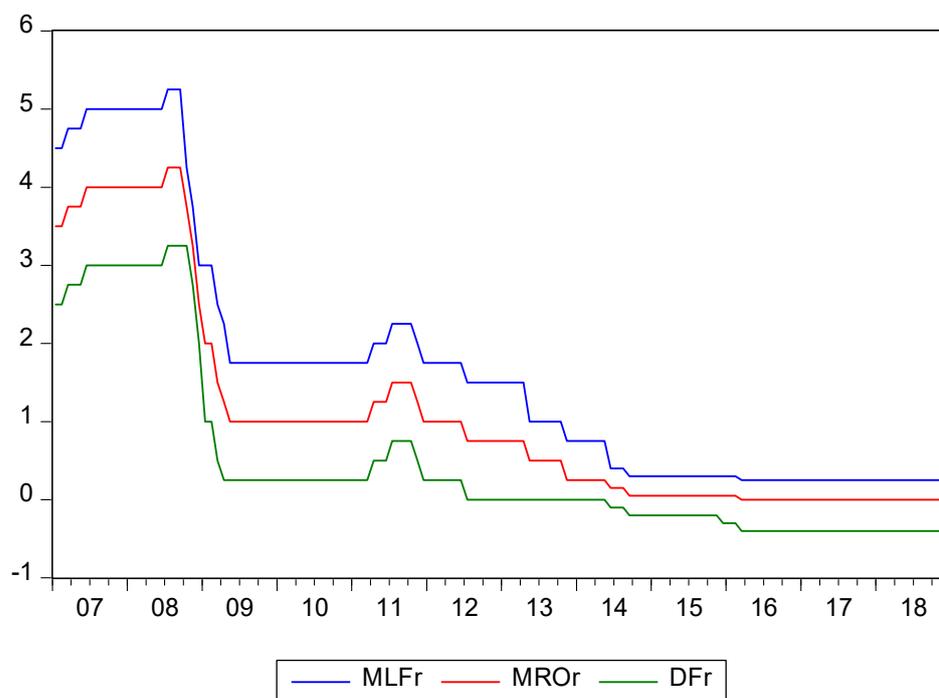

Figure 1. ECB's key interest rates in percentages per annum. Source: Statistical data warehouse of the ECB.

The ECB launched nonstandard monetary policy instruments to influence financing conditions. ECB's interventions include unlimited provision of liquidity to euro area MFIs, maturity extension of monetary operations, expansion of accepted collateral in monetary policy operations, and purchases of private covered bonds (Cour-Thiman and Winkler 2013).

In the stage of sovereign debt crisis, the ECB tried to enhance credit access conditions and to support euro area financially distressed countries. In May 2010, the ECB launched the Securities Market Programme (SMP) to intervene in the secondary markets by buying public financial assets (Martins et al. 2019). At the expiration of the program the euro area monetary authority held a portfolio of EUR 218 billion which was allocated among distressed peripheral member states (EUR 102.8 bill for Italy, EUR 44.3 bill for Spain, EUR 33.9 bill for Greece, EUR 22.8 bill for Portugal, and EUR 14.2 bill for Ireland, Falagiarda and

Reitz 2015). The ECB also activated a complementary covered bond program (CBPP2) in November 2011 and carried out two, 36 month, very longer term refinancing operations (VLTROs). In September 2012, the ECB introduced the outright monetary transactions (OMT) to support distressed countries in secondary financial markets (Chebbi 2019). Additionally, from 2013 the ECB provided forward guidance for its future monetary policy to influence medium- and long-term expectations.

In the third stage of the crisis, starting in mid-2014, the ECB launched the Credit Easing Programme intending to influence financing conditions and to boost economic activity (Falagiarda et al. 2015). The CEP comprised two tranches of four-year maturity, targeted longer term refinancing operations (TLTROs), designated to provide financing to euro area credit institutions in attractive conditions, and the expanded asset purchase programme (APP) which includes purchases of private and public financial assets from secondary markets[4]. Purchases of financial assets under APP were carried out till the end of 2018 involving a total amount of EUR 2.6 trillion[5]. Non-standard monetary policy measures expanded ECB's total assets from 1 trillion in 2007 to 4.7 trillion in 2018[6].

Special emphasis should be given to the fact that four times (in May 2010, March 2012, December 2012, and June 2016) the ECB decided to waive the application of the quality threshold in order for Greek debt securities to be acceptable as collateral in monetary policy transactions[7]. The provision of liquidity to the Greek monetary financial institutions by the ECB was crucial in avoiding a banking default, so, we include those four decisions in the category of liquidity provision (LIQ). As shown in Figure 2, during the Greek debt crisis and in the first quarter of 2015, regional monetary financial institutions received vast amounts of liquidity.
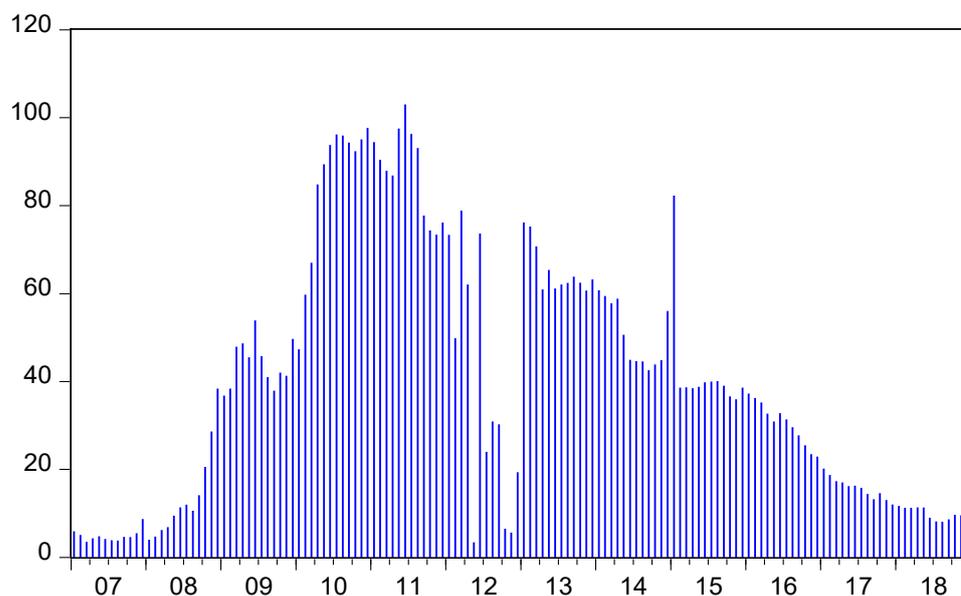
Figure 2. ECB's liquidity provision to Greek monetary financial institutions in billions. Source: Bank of Greece.

The ECB's liquidity provision was mainly used to cover deposit outflows (Louri and Migiakis 2019) while, as shown in Figure 3, from the onset of the sovereign debt crisis, in the middle of 2010, bank loans to the private sector declined significantly.

We must point out that the ECB introduced monetary tools similar to those of other central banks. Major central banks, the Federal Reserve (Fed), the Bank of Japan (BoJ), and the Bank of England (BoE) cut key interest rates, adopted asset purchases programs, undertook longer term liquidity providing operations, and provided forward guidance. While the ECB and the BoJ implemented a negative interest rate policy, Fed and BoE did not adopt this measure (Dell'Ariccia et al. 2018). Moreover, liquidity-providing operations to

commercial banks were more relevant for the ECB due to the bank-based financial structure of the euro area. Another significant difference is that the Fed started large-scale asset purchases in 2009 while, in the same period, ECB introduced purchases of covered bond (CBPP1), a smaller scale program, focusing only on private sector debt securities. The ECB started large-scale purchases of public bonds in 2015 with the expanded APP[8].
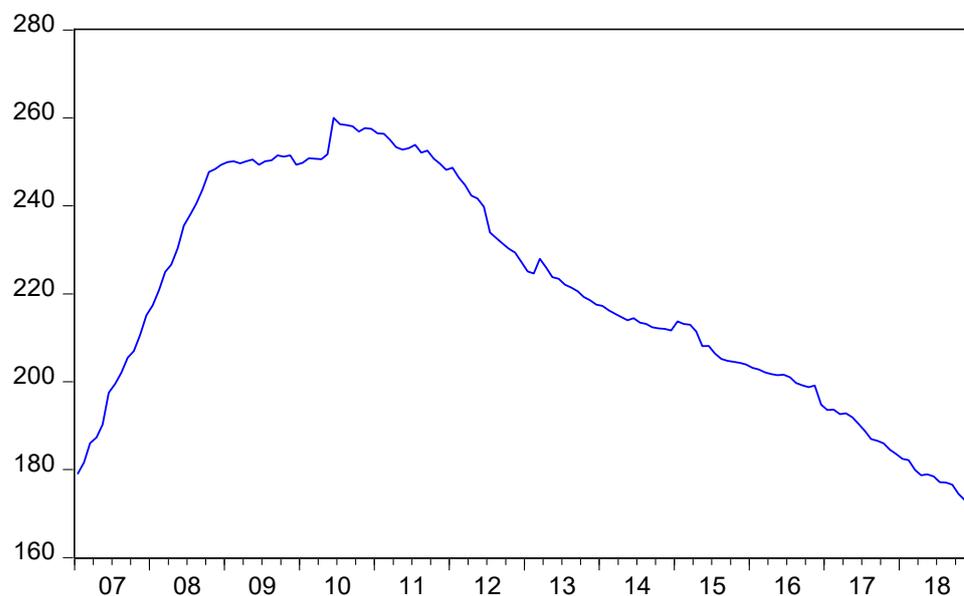

Figure 3. Loans of Greek MFIs to the private sector in billions. Source: Bank of Greece and authors' calculations.

Unconventional monetary policy tools used by the Fed, BoJ, and the BoE aimed at and succeeded in reducing their own government bond yields while the ECB's actions aimed at intra Eurozone public bond spreads and not at the level of German yields. The ECB's tools targeted and succeeded in decreasing peripheral sovereign bond spreads with German counterparts. Additionally, expansionary unconventional measures introduced by the Fed, BoJ, and the BoE caused domestic currency depreciation and corporate bond yield reduction. On the other hand, the ECB's measures resulted in the appreciation of the euro and the rise in yields of Eurozone corporate bonds (Rogers et al. 2014).

3. Literature Review

Various early surveys have studied the influence of monetary policy mainly on the US financial markets. In the 1990s, many researchers used vector autoregressive (VAR) analysis. Thorbecke (1997) using the VAR approach reported that expansionary monetary policy raises stock returns. Patelis (1997) showed that monetary policy variables can significantly predict the US equity returns for the period 1964–1992. Ridogon and Sack (2004) suggested the identification through the heteroscedasticity approach to overcome the endogeneity problem inherent in this kind of research. Ehrmann and Fratzscher (2004) examined the US monetary policy for the period February 1992 to January 2003 using event study methodology. They reported that the firms with low cash flows, low debt-to-capital ratios, high price–earnings ratios, poor credit ratings, small size, high price–earnings ratios, or a high Tobin's q are affected significantly more by Fed's policy announcements. Bernanke and Kuttner (2005) applied the event study approach and documented a significant response of US equity to Fed's policy actions during the period May 1989 to December 2002.

Recent studies have surveyed the effect of the ECB's interventions on bond yields. Trebesch and Zettelmeyer (2014) as well as Falagiarda and Reitz (2015) reported that the SMP decreased the government bond yields of distressed euro area member states. Altavilla et al. (2016) showed that ECB's announcements of OMT decreased the two-year

government bond yields of Spain and Italy by 2 percentage points. Jäger and Grigoriadis (2017) reported that the ECB's exceptional monetary policy actions successfully influenced bond spreads, but heterogeneously with a stronger impact on yields of peripheral countries.

Several research papers have explored the impact of the ECB's monetary policy decisions on capital markets. Rogers et al. (2014) introduced the spread between Italian and German 10-year government bonds yields to measure unconventional monetary policy innovations launched by the ECB. This approach was followed by many other researchers (see among others Haitsma et al. 2016). Fratzscher et al. (2014) examined the influence of the ECB's nonstandard measures on various security yields using high-frequency data and ended up finding positive results. Hau and Lai (2016) found that expansive monetary policy introduced by the ECB is related to a switch from money markets towards capital markets while Georgiadis and Gräb (2016) showed that the announcement of the APP caused global spillovers boosting stock prices worldwide. Haitsma et al. (2016) found that from 1999 to 2015, expansive non-standard monetary policy measures affect, more than conventional policy, the euro area equity indices. Fausch and Sigonius (2018) surveyed the German equity market and documented that, when the real interest rates are negative, equity returns responded to unexpected policy innovations. Pacicco et al. (2019) using panel data analysis and event study methodology concluded that for the period of April 1999 to June 2016, conventional policies heterogeneously affected Eurozone capital markets while the impact of non-traditional measures was homogeneous on markets. Chebbi (2019) found that non-standard monetary policy had a statistically significant and positive impact on stock returns of two core and two peripheral countries. Petrakis et al. (2022) showed that conventional monetary policy measures affected all euro area equity markets while non-conventional actions had a positive effect on core euro area equity markets that were less affected by the economic crisis.

In addition, several economists have analyzed the impact of standard and unconventional policies mainly on macroeconomic variables (i.e., inflation and output). Gambacorta et al. (2014) used the panel structural VAR procedure for eight advanced economies and suggested that, for the sampling period January 2008–June 2011, unconventional policy leads to a temporary rise in output (similar to the one obtained by conventional policy) while the reaction of price level is less persistent and weaker. Kucharcukova et al. (2016) applied factor-augmented VAR econometric techniques to explore the transmission of the ECB's monetary measures on Eurozone countries as well as on six European union countries outside the euro area. Standard monetary shocks affected in a similar way inflation and output while non-conventional measures generated various responses among countries. Boeckx et al. (2017) estimated the impact of the ECB's balance sheet policies, for the period 2007–2014, using the structural VAR framework and found a positive effect on consumer prices of all euro area countries. The output effect was stronger for countries that were less influenced by the financial crisis. Moder (2019) applied the structural Bayesian VAR econometric approach and suggested spillover effects of the ECB's non-conventional monetary policy measures on output and prices of southeastern European countries. Fiorelli and Meliciani (2019) studied the period January 2001 to December 2016 also using the factor-augmented VAR model and concluded that the ECB should combine conventional and non-standard monetary tools to stabilize the Eurozone economies.

There are few surveys exploring the impact of the ECB's monetary interventions on stock returns of financial institutions (see among others Fiordelisi et al. 2014; Ricci 2015). Fiordelisi and Ricci (2016) concluded that for the period June 2007 to June 2012, equity returns of global systematically important financial institutions were influenced by monetary policy announcements but not those of non-financial firms. Fiordelisi and Galloppo (2018) used panel regression methodology and the event study approach to study the responses of monetary and fiscal announcements in 12 worldwide equity markets. They reported that, during the period June 2007 to June 2012, expansionary monetary interventions positively affected banking and market indices.

As we can see, previous scientific investigation concerns macroeconomic variables, bond yields, market indices, and global financial institutions while there is no exclusive research for Greek banking institutions which operated in a different economy with specific financial characteristics. In the period under investigation, Greece was hit harder in relation to any other Eurozone member states by the sovereign debt crisis. The Greek republic faced a great recession and large budget deficits, approved three Economic Adjustment (Bailout) Programs to avoid default, to refinance public debt and to recapitalize banks. Its government bond yields reached unsustainable levels and it was forced to apply tax increases, wage cuts, and other austerity measures. Additionally, Greek MFIs suffered from limited liquidity due to the fall of collateral value, non-performing loans (highest in the euro area), and low capital adequacy ratios (Charalambakis et al. 2017; Louri and Migiakis 2019). For these reasons, Greece and the local MFIs constitute a special case for investigation.

4. Channels of Transmission of Monetary Policy

The literature proposes several different transmission channels of monetary policy that could affect equity returns.

First, we elaborate the conventional channel of interest rate changes. According to this channel, interest rate reductions increase the present value of future cash flows by decreasing the risk-free rate as well as the risk premium and hence equity prices are increased (Bernanke and Kuttner 2005). Moreover, Tobin (1978) supported that the tightening of monetary policy increases inflation, decreases the present value of anticipated earning flows, and therefore depresses equity.

Second, unconventional monetary policy actions may affect stock prices through the portfolio rebalancing channel (see among others Fratzscher et al. 2014; Falagiarda et al. 2015; Georgiadis and Gräb 2016). The ECB's purchases of Eurozone government bonds decrease their yields relative to other assets. Investors are induced to sell them due to lower yields and to rebalance their portfolio towards assets with higher risk-adjusted returns such as stocks.

Third, via the bank lending and direct pass-through channels, ECB could impact stock prices by encouraging investment. TLTROs are designated to decrease banks' costs of funding, preserve lending margins, increase liquidity provision to euro area MFIs, and incentivize them to expand the supply of loans to the real economy. Credit-easing measures encourage borrowing in favorable terms which may leads to higher investment expenditure, positively affecting stock prices.

Fourth, via the signaling channel of forward guidance, the ECB has underscored its intention to keep key interest rates at low levels for a long period of time. This may trigger downward investors' expectations for the future path of interest rates decreasing market volatility and uncertainty. Favorable market conditions are crucial for investment resulting in lower risk premiums and higher equity prices[9].

5. Empirical Approach

Several different procedures have been used to study the impact of monetary policies on equity markets. Some studies apply impulse response functions of VAR models (Patelis 1997; Thorbecke 1997). According to Bredin et al. (2009), the results of VAR methodology depended on the data frequency used, while endogeneity issues were presented. Additionally, Rudebusch (1998) criticized VAR models used in this topic as somewhat artificial. Several other papers (Kholodilin et al. 2009) used the identification through the heteroscedasticity approach of Ridogon and Sack (2004) to overcome endogeneity issues but most researchers apply the event study approach (Fiordelisi et al. 2014; Ricci 2015). Other studies apply both procedures (Rogers et al. 2014; Haitsma et al. 2016). The Ridogon and Sack (2004) method assumes that the variance of policy shocks is higher on days when a monetary policy measure is announced in contrast to the variance on days with no monetary policy news. The event study approach assumes that a monetary policy

measure can affect security prices in a specific event window nearby the date or the time of the announcement. According to Rosa (2011), the event study approach estimates tend to outperform the heteroscedasticity-based estimates, hence, generally the event study approach should be preferred.

In the remaining two subsections we present the data, event study, and regression methodology used in our study.

5.1. Data

Our research analyzes whether interventions introduced by the ECB could affect equity returns of the systematically important Greek regional banks for the period January 2007 to August 2018. Our sampling period extends from the beginning of the financial crisis to the end of the three Greek Economic Adjustment Programs. The four core Greek banks under investigation are the National Bank of Greece, Alpha Bank, Eurobank E.F.G., and Piraeus Bank. These banks participated in the capital exercise of 2011/2012 as well as in the comprehensive assessments (asset quality review and stress test) of 2014 and 2015 organized by the ECB and have been characterized as systemic banks. As mentioned above, there is no exclusive research exploring the ECB's monetary policy announcement measures on Greek banking industry returns as previous research mainly concerns Greek sovereign bond yields and the market index of the Athens stock exchange.

Our dataset consists of 103 important monetary policy interventions, for both traditional and non-standard measures. Non-conventional interventions include monetary easing and liquidity provision. The ECB's measures have shortly been discussed in Section 2. Crucial monetary policy announcements were collected from press releases, press conferences, key speeches, in contrast to the databases of Falagiarda et al. (2015) and Rogers et al. (2014).

We classify the ECB's monetary interventions into four categories: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). As a proxy interest rate changes, we use the main refinancing operations rate. Monetary easing includes ECB's purchases of private and public financial assets (SMP, OMT, PSPP, CBPP, ABSPP, and CSPP). Liquidity provision interventions cover unlimited provision of liquidity to euro area banks through the fixed rate tender procedure with full allotment (FRTPFA), supplementary, very longer term and targeted refinancing operations (SLTRO, VLTRO, TLTRO I, and TLTRO II), expansion of accepted collaterals, and liquidity provision in foreign currency. We also note that the ECB decided four times (in May 2010, March 2012, December 2012, and June 2016) to waive the quality threshold in order for Greek debt securities to be acceptable as collateral in monetary policy transactions.

When the ECB declared more than one type of intervention on the same day, to avoid overlapping events we adopt criteria following Fiordelisi and Galloppo (2018). (a) If all interventions belong to the same category, we encounter them as a single event, (b) the ECB's decisions to change the rate of the main refinancing operations are always considered as main events, (c) decisions to leave a current measure unchanged are considered less important than new measures, and (d) if the above criteria are not enough, we identify, in terms of significance, the main event. Table 1 reports the classification of monetary policy interventions into four categories.

Table 1. Classification of the ECB's monetary policy interventions announced between January 2007 and August 2018 into four related categories[10].

Monetary Policy Category	Number of Interventions
Interest rate cuts (IRC)	15
Interest rate increases (IRIN)	5
Monetary easing (ME)	22
Liquidity provision (LIQ)	61
Total	103

Therefore, our sample consists of 412 observations, as we essentially study the impact of 103 ECB's monetary interventions on equity returns of four systemic Greek banks.

5.2. Methodology

Regarding methodology, the present investigation follows the practice of Fiordelisi and Galloppo (2018). Firstly, daily returns from each of the four systemic Greek banks (Alpha Bank, Eurobank, National Bank, and Peireaus Bank) and the market index are calculated as:

$$R_{i,t} = \ln(P_{i,t}/P_{i,t-1}) \tag{1}$$

Data for the bank equity prices and the general composite index of Athens stock exchange were retrieved from Datastream.

Subsequently we employed an event study procedure as in MacKinlay (1997). For each announcement date, we estimate Abnormal Returns (ARs) and Cumulative Abnormal Returns (CARs). Each AR is calculated as the difference between actual-real return and normal-expected return. Normal-expected returns are computed using the market model with the Ordinary Least Squares (OLS) estimation procedure and an estimation period of 40 trading dates ending 10 trading dates before the event period[11].

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}) \tag{2}$$

Then, Cumulative Abnormal Returns are calculated for one day event period (0,0), two day event window (0,+1), and three day event window (−1,+1) as:

$$CAR_i^{(t1,t2)} = \sum_{t=t1}^{t2} AR_{i,t} \tag{3}$$

To isolate the impact of announcements, the estimation period is not connected to the event period.

We employ an event window up to three days to avoid "contamination" of our results. According to Haitsma et al. (2016), too small a window might lose part of the responses to the monetary policy news, but too wide a window might infect the monetary interventions with other news.

Table 2 presents the descriptive statistics of Cumulative Abnormal Returns. We find a positive reaction of Greek banking security returns to the ECB's monetary policy interventions. Our result shows up stronger, if we consider that during the examination period, the general composite index of Athens stock exchange recorded a negative average daily return of 0.064% for 2872 trading dates.

Table 2. Descriptive statistics of Cumulative Abnormal Returns on announcement dates for the period January 2007 to August 2018.

Variable	Mean	Median	Std. Dev.
CAR(0,0)	0.001533	0.000253	0.042928
CAR(0,+1)	0.001160	0.001112	0.072824
CAR(−1,+1)	0.000305	−0.001588	0.077599

In the second step, an OLS multivariate panel regression analysis is performed using dummy variable procedure aiming to recognize the determinants of stock reactions.

The model used in our empirical work is the following:

$$CAR_{i,j}^{(t1,t2)} = \gamma + \sum_{j=1}^{n} \beta_j X_{i,j}^m + \varepsilon_{i,j} \tag{4}$$

CAR for the each i-th bank (i = 1, 2, . . . , 4) to the j-th intervention (j = 1, 2, 3, . . . , 103) over each event window (t_1,t_2) is the dependent variable. $X_{i,j}^m$ is the vector of dummy variables identifying each monetary policy category. Dummies identifying the category of monetary policy interventions are: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). For example, IRC is a dummy variable that takes a value of one (1) the day in which the ECB's governing council decided to decrease the main refinancing operations rate (MROr), and zero (0) otherwise. During the examination period, the ECB announced the reduction of the MROr 15 times. Respectively, LIQ is a dummy variable that takes a value of one (1) the day of a liquidity provision announcement and zero (0) otherwise (m = IRIN, IRC, ME, LIQ). Table 1 in Appendix A addresses our classification of the ECB's monetary policy interventions. $\varepsilon_{i,j}$ is the error term. To avoid multicollinearity problems, we did not estimate our model using jointly IRC, LIQ, and ME.

6. Discussion of Results

Tables 3–5 report our empirical findings regarding the reaction of the Greek banking industry to conventional and non-standard monetary policy interventions introduced by the ECB[12].

Table 3. Greek banking sector stock reaction to the ECB's monetary policy interventions. One-day event window.

	Dependent Variable CAR(0,0)					
Independent Variables	**coeff.**	**std.error**	**coeff.**	**std.error**	**coeff.**	**std.error**
γ	−0.000868	0.002274	−0.002450	0.002619	−0.003233	0.005615
IRC	0.016485 *	0.005959	0.018067 *	0.006087	0.017370 **	0.006984
ME			0.006327	0.005239		
LIQ					0.002776	0.004559
R squared	1.84%		2.19%		1.84%	

Note: This table reports the Greek banking sector stock reaction to the ECB's monetary policy announcements. The dependent variable is CAR(0,0). The independent variables are IRC, a dummy variable that specifies announcements for interest rate reductions, ME, a dummy variable that specifies announcements for monetary easing, and LIQ, a dummy variable that indicates announcements for liquidity provision. *, ** denote that estimates are statistically significant at 1%, 5% levels, respectively.

Table 4. Greek banking sector stock reactions to the ECB's monetary policy interventions. Two-day event window.

	Dependent Variable CAR(0,1)					
Independent Variables	**coeff.**	**std.error**	**coeff.**	**std.error**	**coeff.**	**std.error**
γ	−0.003789	0.003833	−0.005852	0.004427	−0.007166	0.006801
IRC	0.033984 *	0.010045	0.036047 *	0.010287	0.037361 *	0.011514
ME			0.008253	0.008854		
LIQ					0.004953	0.008236
R squared	2.72%		2.9%		2.8%	

Note: The dependent variable is CAR(0,+1). The same independent variables used as in Table 3. * denotes statistical significance at the 1% level.

Table 5. Greek Banking sector stock reactions to the ECB's monetary policy interventions. Three-day event window.

Independent Variables	Dependent Variable CAR(−1,1)					
	coeff.	std.error	coeff.	std.error	coeff.	std.error
γ	−0.003466	0.004112	−0.006010	0.004748	−0.007282	0.007296
IRC	0.025897 **	0.010776	0.028441 **	0.011032	0.029713 **	0.012352
ME			0.010174	0.009495		
LIQ					0.005597	0.008835
R squared	1.39%		1.67%		1.48%	

Note: The dependent variable is CAR(−1,+1). The same independent variables used as in Table 3. ** denotes that estimates are statistically significant at the 5% level.

First, interest rate cut announcements have positive and statistically significant impacts on banks' Cumulative Abnormal Returns. In panel linear regressions with IRC as the independent variable, coefficients of IRC are statistically significant at the 1% level when the dependent variable is either CAR(0,0) or CAR(0,+1) and at the 5% level when the dependent variable is CAR(−1,+1). Additionally, in all multivariate panel regressions with combinations of IRC with LIQ and ME, the coefficients of IRC remain statistically significant at 1% and 5% levels, respectively[13]. Our results show up stronger for the two-day event period (the day of announcement and the next day). Furthermore, we evidence rather stable estimated coefficients for IRC for each event window. This interesting result suggests that ECB's expansionary conventional monetary policy measures produce positive and statistically significant impacts on Greek banking returns over a very short time event window even in a crisis period.

According to the interest rate channel (Bernanke and Kuttner 2005), interest rate reductions increase the present value of future cash flows by decreasing the risk-free rate as well as the risk premium and hence equity prices are increased. Interest rate cuts decrease the cost of banks' funding, increase the provision of liquidity, boost the expansion of credit, increase the loan demand, improve the interest margins, increase the collateral provided by debt holders, strengthen bank revenues, and enhance the equity prices. Additionally, the ECB's intention to keep the key interest rates at the zero lower bound for an extended period of time affects downward lending and deposit rates as well as other short-term and long-term rates. This signaling process decreases the market uncertainty and leads to adjustment in demand of equity prices due to investors aiming at higher yields. Previous research (e.g., Fiordelisi and Ricci 2016) supports our findings about the stock reaction of financial institutions on expansionary conventional monetary policy interventions. Additionally, Fiordelisi and Galloppo (2018) reported that during the crisis period, the investors believed that interest rate cuts is an effective tool for boosting the banking industry. Moreover, Petrakis et al. (2022) showed that that conventional monetary policy interventions affected distressed Eurozone equity markets.

Contractionary convectional monetary policy announcements (interest rate increases) have no statistically significant explanatory power on CARs. Additionally, in multivariable regressions, announcements concerning unconventional, non-standard monetary measures (monetary easing and liquidity provision) are found to produce positive but not statistically significant effects on Greek banking stock returns[14].

We observed that since the last four months, 2008 until mid-2009, the ECB cut rapidly the main refinancing operations rate to dominate the first stage of the crisis but margins for more expansive conventional policy were limited because the MROr was close to the zero level. Due to this fact, the Eurozone monetary authority launched unconventional measures mainly in the second and third stages of the crisis.

As we previously noticed, during and after the debt crisis, the Greek government implemented three economic and adjustment programs accompanied with austerity measures that decreased investors' expectations about the effectiveness of non-traditional measures.

The restructuring of public debt that caused great losses to private bondholders, the recapitalization of systemic Greek banks from the official sector, and the imposition of capital controls resulted in the gradual loss of investors' confidence towards the Greek economy and the regional capital market.

As shown in Figure 3, in the case of Greek MFIs, the bank lending and direct pass-through channels were not activated as credit to the private sector declined from the onset of the debt crisis. Greek MFIs suffered from a liquidity shortage due to inadequate collateral, high non-performing loan ratios, low capital adequacy ratios, and high deposit withdrawals (Charalambakis et al. 2017; Louri and Migiakis 2019). The ECB decided four times to waive the application of the quality threshold and accepted Greek debt securities as collateral in monetary policy transactions, but these decisions were not enough to boost credit expansion as loans to households and corporations became negative in net terms.

In addition, the portfolio rebalancing mechanism did not operate properly. The extreme uncertainty conditions prevailed in Greece during and after the eruption of the debt crisis and the possibility of sovereign default along with the financial fragility of Greek MFIs forced investors to shift their funds from Greece to non-stressed countries eliminating the impact of non-standard measures on local banking equity returns. Another reason that the portfolio rebalancing channel did not work properly was the fact that the Greek private and official sector debt securities were not eligible for APP operations because of the low credit rating.

Previous studies support our results. Pacicco et al. (2019) reported that Greek stock market did not react to the ECB's non-conventional monetary interventions in the aftermath of the debt crisis. Additionally, Vortelinos and Gkillas (2019) found that equity markets of distressed Eurozone members states did not show a significant response to the ECB's monetary events in subperiods following the eruption of the debt crisis while investors were directed to non-troubled economies. Boeckx et al. (2017) pointed out that the ECB's unconventional balance sheet policy turned out to be more effective in countries that were less influenced by the economic crisis.

Robustness Tests

To investigate if the effects of the ECB's conventional and non-traditional monetary policy measures change over time, we decided to divide our sampling period into two different subperiods. As we previously noticed, on the 02/05/2010 Greece's first rescue program was agreed (in the form of a Memorandum of Understanding, MoU) with the IMF, the European member states, and the ECB, totaling a multilateral loan of EUR 110 billion. So, the first sub-period (the pre-bailout sub-period), is between 01/01/2007 and 01/05/2010 and covers the subprime crisis phase and the global financial crisis phase. The second sub-period (the bailout sub-period) extends from 02/05/2010 to 20/08/2018 and covers the Greek debt crisis along with the three adjustment programs. In the first sub-period, the ECB reduced the key interest rate seven times while in the second sub-period eight times (see Table A1 in Appendix A).

To search further the robustness of our empirical results, we re-estimated our equation introducing a time dummy variable.

$$\text{CAR}_{i,j}^{(t1,t2)} = \gamma + \sum_{j=1}^{n} \beta_j X_{i,j}^m + \delta TD_t + \varepsilon_{i,j} \qquad (5)$$

TD is a time dummy variable that takes the value of zero (0) at the first, pre-bailout sub-period from 1 January 2007 to 1 May 2010, and the value of one (1) at the second bailout sub-period from 2 May 2010 to 20 August 20018[15]. Tables 6–8 report our empirical findings.

Table 6. Greek banking sector stock reaction to the ECB's monetary policy interventions. One-day event window.

Independent Variables	Dependent Variable CAR(0,0)					
	coeff.	std.error	coeff.	std.error	coeff.	std.error
γ	−0.002575	0.003681	−0.002979	0.003700	−0.003233	0.005615
IRC	0.016811 *	0.005978	0.018093 *	0.006095	0.017370 **	0.006984
ME			0.005956	0.005556		
LIQ					0.000785	0.005059
TD	0.002590	0.004395	0.000943	0.004655	0.002776	0.004559
R squared	1.93%		2.20%		1.93%	

Note: The same dependent and independent variables used as in Table 3. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. *, ** denote that estimates are statistically significant at 1%, 5% levels, respectively.

Table 7. Greek banking sector stock reactions to the ECB's monetary policy interventions. Two-day event window.

Independent Variables	Dependent Variable CAR(0,1)					
	coeff.	std.error	coeff.	std.error	coeff.	std.error
γ	−0.002154	0.006219	−0.002856	0.006249	-0.005958	0.009482
IRC	0.033672 *	0.010099	0.035901 *	0.010296	0.036905 *	0.011795
ME			0.010359	0.009385		
LIQ					0.004544	0.008544
TD	−0.002481	0.007425	−0.005346	0.007863	−0.001409	0.007700
R squared	2.74%		3.03%		2.81%	

Note: The same dependent and independent variables used as in Table 4. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. * denotes that estimates are statistically significant at the 1% level.

Table 8. Greek banking sector stock reactions to the ECB's monetary policy interventions. Three-day event window.

Independent Variables	Dependent Variable CAR(-1,1)					
	coeff.	std.error	coeff.	std.error	coeff.	std.error
γ	−0.000482	0.006670	−0.001391	0.006698	−0.004330	0.010171
IRC	0.025328 **	0.010831	0.028216 **	0.011035	0.028598 **	0.012651
ME			0.013420	0.010059		
LIQ					0.004596	0.009164
TD	−0.004529	0.007963	−0.008240	0.008428	−0.003444	0.008259
R squared	1.46%		1.90%		1.53%	

Note: The same dependent and independent variables used as in Table 5. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. ** denotes that estimates are statistically significant at 5%.

Our empirical results are remarkably consistent with those reported above. More specifically, in all panel univariate and multivariate regressions, coefficients of IRC have similar magnitudes and statistical significance as before, while coefficient estimates on ME and LIQ are positive but not statistically significant.

The inclusion of the TD time dummy variable confirms that there is a no different effect between pre-bailout and bailout crisis periods. Therefore, we underscore a sustainable effect lasting for the whole investigating period, from January 2007 to August 2018. Additionally, Fiordelisi and Galloppo (2018) found that the statistically significant banking

sector reaction on expansionary monetary policy measures is irrelevant with the evolution of the financial crisis.

7. Conclusions

The global banking system has come under unprecedented pressure at a time of economic crisis. Interbank relations have created an interconnected and unifying system that dealt slowly with the risks and problems caused by the crisis. The new non-conventional monetary policy tools introduced by central banks were a milestone in global banking history having contributed to the solvency of the whole banking system.

Greece and the regional banking system faced the devastating consequences of the sovereign debt crisis. In early 2010, the Greek government lost access to financial markets and was forced to launch the first economic and adjustment program to receive financial assistance and to avoid default. Greece implemented two more economic and adjustment programs until August 2018, due to the ongoing economic recession and the budget deficits. In the onset of the financial crisis, the regional monetary financial institutions (MFIs) were healthy and resilient as they were among the best capitalized banks in Europe but, eventually, they were weakened by the sovereign debt crisis.

From the onset of financial crisis, the ECB implemented a wide set of traditional and unconventional monetary policy interventions to influence financing conditions and to boost economic activity in the euro area. Our research examined the response of Greek banking stock returns to these measures during the period of January 2007 to August 2018. In the first step of our study, we collected 103 significant monetary policy announcements and classified them to several categories. In the second step we performed an event study and panel regression analysis to estimate banking stock reactions to the collected monetary interventions.

Our results indicate that market participants appreciate expansionary conventional monetary policy interventions, introduced by the ECB. This type of policy activates the interest rate transmission mechanism and is found to be efficient in restoring investors' trust in Greek banking stocks in a very short event window.

The upcoming sovereign debt crisis in mid-2010, the uncertainty about the country's prospects as a member state of Eurozone, the three economic and adjusted programs implemented by the Greek government, the restructuring of public debt, the high stock of non-performing loans, and finally the imposition of capital controls resulted in a gradual loss of investors' confidence towards the Greek economy and regional monetary financial institutions. As a result, investors shifted their funds from the Greek capital market to non-stressed countries limiting the effectiveness of non-standard measures on local banking equity returns. Additionally, the two main unconventional monetary policy transmission channels, the portfolio rebalancing, and the direct pass-through, that could boost bank equity prices, did not operate properly in the case of Greece due to the financial fragility of local banks and the exclusion of Greek private and public debt securities from the expanded APP operations.

We consider some limitations in our research as we analyzed only monetary policy measures and did not include the impacts of financial support, fiscal, and state aid policies as well as announcements about macroeconomic and fiscal data (e.g., inflation, output, unemployment, and budget deficit) that could affect equity prices. Despite these limitations, our study provides interesting findings for investors and decision makers. Our results raise concern about the effectiveness of unconventional measures on a peripheral capital market (Greek equity market) designed by the policy makers. Furthermore, our findings are useful for investors because they shed light on the impact of traditional and unconventional monetary policy interventions on stocks of the Greek banking sector which was operating in a very turbulent economic environment with extreme uncertainty conditions.

Today, the Greek banking sector has overcome most of the problems of the economic and debt crisis. The three rounds of recapitalization improved noticeably capital adequacy ratios, the stock of non-performing loans decreased significantly, and the investors' in-

terest returned. Nevertheless, the future stands ahead, and the local monetary financial institutions seem ready to contribute to the economic development of the country.

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Appendix A

Table A1. Announcement dates of ECB's monetary policy interventions (January 2007–August 2018).

Date	Description	MRO Rate Change	Category of Policy
8 March 2007	G.C. meeting	+0.25	IRIN
6 June 2007	G.C. meeting	+0.25	IRIN
22 August 2007	Supplementary LTROs announcement		LIQ
6 September 2007	Supplementary LTROs		LIQ
8 November 2007	Renewal of supplementary LTROs		LIQ
10 January 2008	US dollar liquidity providing operations		LIQ
7 February 2008	Renewal of two supplementary LTROs		LIQ
11 March 2008	US dollar liquidity operations		LIQ
28 March 2008	Introduction of supplementary 6-month LTROs		LIQ
2 May 2008	US dollar liquidity providing operations		LIQ
3 July 2008	G.C. meeting	+0.25	IRIN
30 July 2008	US dollar liquidity providing operations		LIQ
31 July 2008	Renewal of two LTROs		LIQ
4 September 2008	Renewal of LTROs		LIQ
18 September 2008	US dollar liquidity providing operations		LIQ
26 September 2008	US dollar liquidity providing operations		LIQ
29 September 2008	Temporary swap lines with the Fed		LIQ
7 October 2008	Enhance of LTROs and expansion of US dollar liquidity operations		LIQ
8 October 2008	Fixed rate tender procedure with full allotment (FRTPFA) for MROs	−0.5	IRC
13 October 2008	US dollar liquidity providing operations		LIQ
15 October 2008	Expansion of assets eligible as collateral, enhancement of LTROs		LIQ
6 November 2008	G.C. meeting	-0.5	IRC
4 December 2008	G.C. meeting	−0.75	IRC
18 December 2008	Fixed rate tender procedure with full allotment for MROs		LIQ
19 December 2008	US dollar liquidity providing operations		LIQ
15 January 2009	G.C. meeting	−0.5	IRC
3 February 2009	Extension of temporary swap lines with the Fed		LIQ
5 March 2009	Continuation of FRTPFA for MROs and LTROs	−0.5	IRC
19 March 2009	US dollar liquidity providing operations		LIQ
2 April 2009	G.C. meeting	−0.25	IRC
6 April 2009	Establishment of a reciprocal currency arrangement with the Fed		LIQ
7 May 2009	Covered bond purchases (CBPP1) and one-year LTROs	−0.25	IRC
4 June 2009	Technical modalities of CBPP1		ME
25 June 2009	Extension of liquidity swap arrangements with the Fed		LIQ
24 September 2009	GovC decided to continue US dollar liquidity operations		LIQ
3 December 2009	Continuation of FRTFA for MROs, and enhancement of LTROs		LIQ
4 March 2010	Continuation of FRTFA for MROs, and enhancement of LTROs		LIQ
3 May 2010	Change in eligibility of Greek debt instruments		LIQ
10 May 2010	Securities market programme (SMP)		ME
10 June 2010	FRTPFA in the regular 3-month LTROs		LIQ
2 September 2010	MROs and 3-month LTROs at FRTPFA		LIQ
2 December 2010	MROs and 3-month LTROs at FRTPFA		LIQ

Table A1. *Cont.*

Date	Description	MRO Rate Change	Category of Policy
17 December 2010	Temporary swap facility with the Bank of England		LIQ
21 December 2010	Extension of liquidity swap arrangements with the Fed		LIQ
3 March 2011	MROs and 3-month LTROs at FRTPFA		LIQ
7 April 2011	G.C. meeting	+0.25	IRIN
9 June 2011	MROs and 3-month LTROs at FRTPFA		LIQ
29 June 2011	Extension of liquidity swap arrangements with the Fed		LIQ
7 July 2011	GovC meeting	+0.25	IRIN
4 August 2011	MROs, 3-month and 6-month LTROs at FRTPFA		LIQ
8 August 2011	Reactivation of SMP for Italy and Spain		ME
25 August 2011	Extension of liquidity swap arrangements with the Fed		LIQ
15 September 2011	US dollar liquidity operations in coordination with other CB		LIQ
6 October 2011	Launch of new covered bond purchase program (CBPP2)		ME
3 November 2011	Technical modalities of CBPP2	−0.25	IRC
30 November 2011	Establishment of a temporary network of reciprocal swap lines		LIQ
8 December 2011	Two 3-year LTROs, increase of collateral availability	−0.25	IRC
21 December 2011	Results of first 3-year LTRO		LIQ
9 February 2012	Approval of National credit claims criteria		LIQ
28 February 2012	Results of second 3-year LTRO		LIQ
8 March 2012	Eligibility of Greek bonds in Eurosystem credit operations		LIQ
6 June 2012	MROs and 3-month LTROs at FRTPFA		LIQ
22 June 2012	Increase of collateral availability for counterparties		LIQ
5 July 2012	G.C. meeting	−0.25	IRC
26 July 2012	Draghi's speech in London "whatever it takes . . . OMT"		ME
2 August 2012	Outright monetary transactions-OMT		ME
6 September 2012	Technical details of OMTs		ME
12 September 2012	Extension of liquidity swap arrangements with the BoE		LIQ
6 December 2012	MROs and 3-month LTROs at FRTPFA		LIQ
13 December 2012	Extension of liquidity swap arrangements with the Fed		LIQ
19 December 2012	Eligibility of Greek debt instruments		LIQ
21 February 2013	Publishing of the Eurosystem's holdings acquired under SMP		ME
22 March 2013	Collateral rules		LIQ
2 May 2013	Extension of MROs and 3-month LTROs at FRTPFA	−0.25	IRC
16 September 2013	Extension of liquidity swap arrangements with the BoE		LIQ
31 October 2013	Standing swap arrangements with other central banks		LIQ
7 November 2013	Extension of MROs and 3-month LTROs at FRTPFA	−0.25	IRC
5 June 2014	Targeted LTROs launched and other measures	−0.1	IRC
17 June 2014	US dollar liquidity providing operations		LIQ
3 July 2014	Details for first series of TLTROs		LIQ
29 July 2014	Legal acts for TLTROs		LIQ
04 September 2014	CBPP3 and ABSPP announcement	−0.1	IRC
18 September 2014	The ECB allots €82.6 billion in TLTRO1		LIQ
2 October 2014	Details for ABSPP and CBBP3		ME
17 November 2014	M. Draghi, speech at the E.P.		ME
4 December 2014	Q.E. programme with sovereign bonds (Draghi's press conference)		ME
22 January 2015	Expanded Asset Purchase Programme (APP) and other measures		ME
5 March 2015	PSPP details and implementation		ME
3 September 2015	Decision to increase the PSPP issue share limit		ME
23 September 2015	ECB adjusts purchase process in ABSPP		ME
3 December 2015	Extension of APP until the end of March 2017.		ME
10 March 2016	Increase of monthly purchases under APP, launch of TLTRO2 and CSPP	−0.05	IRC
21 April 2016	Details for CSPP		ME
3 May 2016	Legal acts on the second series of TLTROs		LIQ
2 June 2016	The Eurosystem will start making purchases under CSPP		ME
22 June 2016	ECB reinstates waiver affecting the eligibility of Greek bonds		LIQ
5 October 2016	Changes to collateral eligibility criteria		LIQ
3 November 2016	ECB reviews its risk control framework for collateral assets		LIQ
8 December 2016	APP calibration, EUR 60 billion monthly purchases until December 2017		ME
19 January 2017	Details for PSPP		ME
26 October 2017	APP calibration, EUR 30 billion monthly purchases until September 2018		ME

Table A1. *Cont.*

Date	Description	MRO Rate Change	Category of Policy
14 December 2017	Changes to collateral eligibility criteria		LIQ
14 June 2018	APP transition, EUR 15 billion monthly purchases until December 2018		ME

Notes: This table presents announcements of the ECB's monetary policy measures for the period January 2007 to August 2018. We classify ECB's monetary interventions into four categories: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). When ECB declared more than one category of intervention on the same day, to avoid overlapping events we adopted criteria following Fiordelisi and Galloppo (2018). (a) If all interventions belong to the same category, we encounter them as a single event, (b) ECB's decisions to change the rate of main refinancing operations are always considered as main events, (c) decisions to leave a current measure unchanged are considered less important than new measures, and (d) if the above criteria are not enough, we identify, in terms of significance, the main event.

Notes

[1] See Floros and Chatziantoniou (2017) for more details about the Greek debt crisis.

[2] For details about European Stability Mechanism and European Financial Stability Facility loans to euro area peripheral member states, see https://www.esm.europa.eu/, accessed on 30 August 2022.

[3] After the share capital increases, the Hellenic Financial Stability Fund on behalf of Greek government became the main shareholder of the four core banks.

[4] For details about expanded asset purchasing programme, see European Central Bank (2019), Economic Bulletin, issue 2.

[5] Expanded APP consists of four programs for purchases of covered bonds, asset backed securities, public sector bonds, and corporate sector bonds (CBPP, ABSPP, PSPP, and CSPP).

[6] Source: statistical data warehouse of the ECB.

[7] See relevant press releases on 3 May 2010, 8 March 2012, 19 December 2012, and 22 June 2016, European Central Bank (2010, 2012a, 2012b, 2016).

[8] For more details see European Central Bank (2021), Assessing the efficacy, efficiency, and potential side effects of the ECB's monetary policy instruments since 2014, occasional paper series, no. 278.

[9] For an overview of the unconventional transmission channels, see European Central Bank (2015), Economic Bulletin, issue 7.

[10] See Table A1 in Appendix A for a detailed presentation of interventions along with their categorization.

[11] For the return generating process of market model, we follow the procedure of Hendricks and Singhal (2003), Vortelinos and Gkillas (2019).

[12] A multivariable panel regression model was estimated for a five-day event period; results are available upon request.

[13] We did not estimate our model using jointly IRC, LIQ, ME as independent variables as we noticed multicollinearity issues.

[14] In Tables 3–5 we present only statistically significant results. Outcomes of univariate panel regressions with each of IRIN, ME, and LIQ as independent variable are available on request.

[15] Ricci (2015), Fiordelisi and Galloppo (2018) as well as Vortelinos and Gkillas (2019) used the same procedure to investigate monetary impacts over time.

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